

Management techniques employed on MSL for the IV&V project



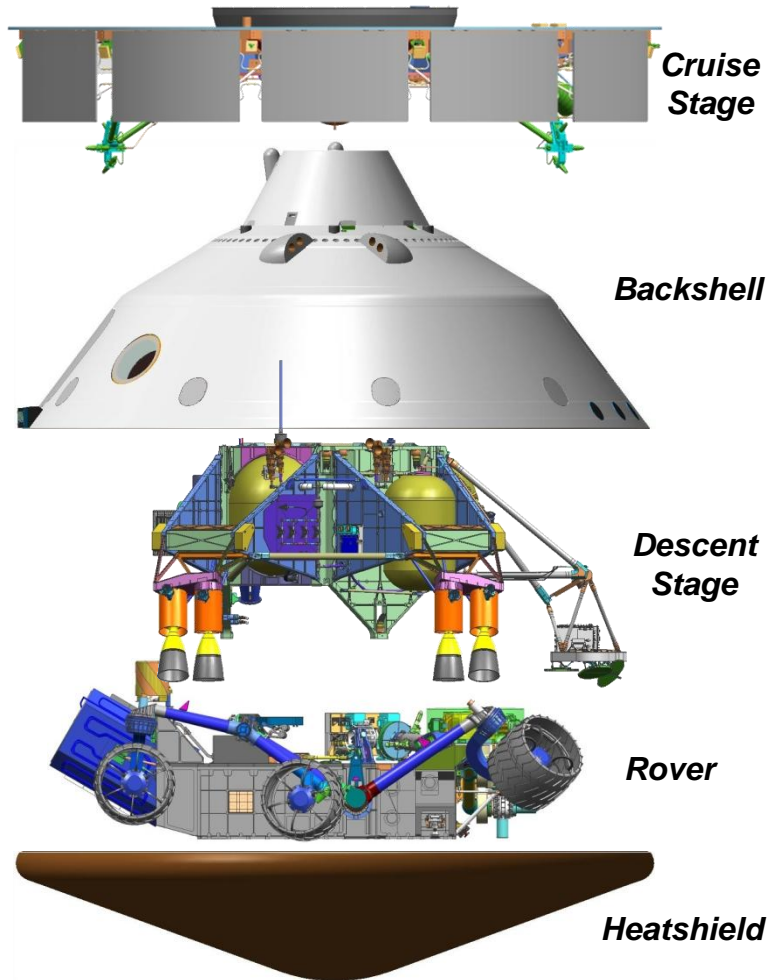
Frank Huy, Shirley Savarino
September 15, 2010

Agenda

- A short history of MSL project
- Some of the challenges and MSL management solutions
 - How we manage the IV&V project
 - How the IV&V project interfaces with the development project

The focus of this presentation will be on challenges faced by the MSL IV&V project and techniques employed to meet these challenges. Nothing novel, more just solid techniques consistently executed.

The MSL Project



Science

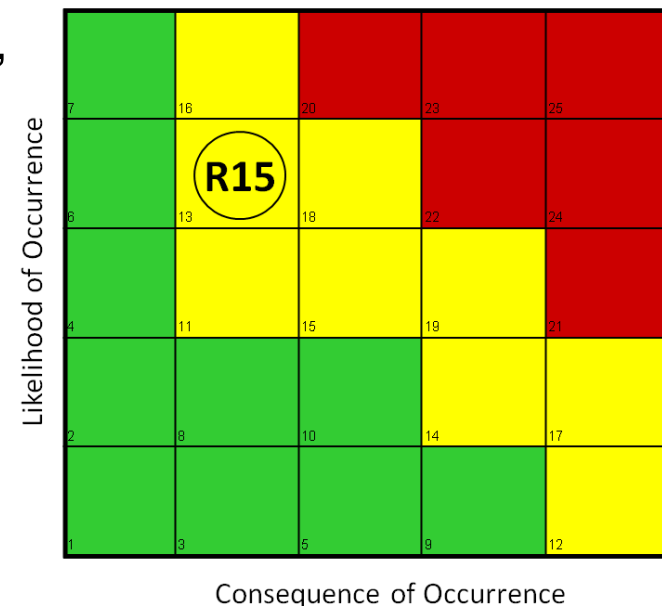
- *Past & Present Habitability of Mars*
- *Highly Capable Analytical Laboratory*
- *Next Generation Remote Sensing & Contact Investigations*
- *Suite of Environmental Monitoring Instruments*

Key MSL Challenges

- *EDL*
- *SA/SPaH development; sample integrity*
- *Payload development*

MSL Launch Delay and Impact on IV&V project

- In Jan 2009, the MSL project announced a launch slip from Fall 2009 to Fall 2011
- The project decided to stay within the FY09 budget allocation and focused efforts on critical path items, which didn't include FSW
 - MSL FSW project was largely disbanded, built up in Sept 09
 - MSL IV&V project employed a similar strategy
- IV&V had an internal risk, R15 (Aug 10)
 - “Impact of project ramp up to FY10 IV&V”
 - Required mitigation plan, which was shared between NASA and contractor mgmt
 - Deliberate efforts to mitigate allowed this risk to be closed in Nov 10
- MSL Staff: 1.5 (Aug 09), 15 (Aug 10)



MSL FSW

- MSL FSW is currently 3.1 MSLOC, with estimate of 4.5 MSLOC upon completion
 - ~4x larger than MER (legacy mission)
 - Approximately 70-75% of code is autogenerated
 - MSL requirements and design are provided amongst 70 Functional Design Documents and 150 Software Description Documents
 - Post launch capability is already planned (upload FSW during cruise)
- ~65% of MSL FSW is in scope for IV&V (EDL, SA/SPaH, ASO)
- MSL utilizes a series of waterfalls to implement its software

MSL IV&V Project – Sub Teams

- 5 subteams identified with IV&V project
 - 3 deal with development phases
 - 2 work across development phases to add rigor to most critical areas of project

	FDDs Available to Support MSL IV&V Requirements Analysis	Code/SDDs and Command Dictionary Available to support MSL IV&V Design/Code Analysis	Test Procedures and Analysis Products begin to be available to support MSL IV&V Test Analysis	
Build A	1-Sep-2009	1-Dec-2009	1-Feb-2009	
Build B	1-Dec-2009	1-Apr-2010	1-Jun-2010	Interface Analysis on EDL Scenarios
Build C	1-Apr-2010	1-Aug-2010	1-Oct-2011	Fault Protection Analysis (Cruise/EDL)
Build D	1-Aug-2010	1-Dec-2010	1-Feb-2011	Interface Analysis on SA/SPaH Scenarios
Build E	1-Dec-2010	1-Apr-2011	1-Jun-2011	Fault Protection Analysis (Surface)
Build F	1-Apr-2011	1-Aug-2011		Interface Analysis on Integrated Surface Scenarios
Build G	1-Aug-2011	1-Dec-2011		
	IV&V Analysis Complete			
	IV&V Analysis Ongoing			

MSL IV&V Project – Technical Rigor

- MSL IV&V schedule matched to build schedule. IV&V schedule is at higher level, when we approach a task, we address specifics through technical rigor
- Technical rigor is implemented through work instructions
 - The MSL work instructions are a level of detail deeper than the Facility processes (to match specific artifacts)
 - Compliant to WBS and associated processes; consistent with IEEE 1012
 - Implement IV&V using project development artifacts
 - Developed by the subteam, with benefit of context, buy-in
 - PM approved
- Used as a basis to develop schedule, monitor progress

Example: MSL Work Instruction/Cycle Schedule

Clear responsibility assignments, tracking of planned and actual dates

Cycle Schedule companion to work instructions, which shows how to do each subtask

Interface Validation - GOAL: Begin: 5/17/10 End: 7/9/10		Assigned to:	Planned Start	Planned Completion (Init)	Actual Start	Targeted Completion	Actual Completion	Notes
2	Requirements Parsed (use 5/11/10 worksheet)	Dustin/ Paula	5/24/2010	5/27/2010	5/24/2010	5/27/2010	6/4/2010	
17								
18	Service Attributes	Dustin/ Paula	5/27/2010	6/11/2010		6/30/2010		
45								
46	Create Scenarios	All	6/21/2010	7/2/2010	7/1/2010	7/9/2010		
56								
57	Scenario Based Analysis Val/Ver	All	7/5/2010	8/6/2010	7/12/2010			
58	Scenario Based Analysis Methods - Val	Dustin	6/21/2010	6/25/2010				6/23: Develop work instructions June 30 7/26 - put work instructions worked last week into group
59	Sandy's Visit		7/26/2010	8/12/2010				
63	Correlate associated requirements - Cruise - EDL	Dustin	7/26/2010	8/25/2010				
64	Correlate associated requirements - Powered Descent	Paula	7/26/2010	8/25/2010				
65	Analyze to ensure requirements completely specify I/F - Cruise-EDL	Dustin	7/26/2010	8/25/2010				
66	Analyze to ensure requirements completely specify I/F - Powered Descent	Paula	7/26/2010	8/25/2010				
67	ECR Events FDD Regression Analysis - update models and analysis against new FDD - update requirements correlation, and reassess if new TIMs need to be written - Update prior findings	Paula/Dustin	8/24/2010	8/31/2010	8/24/2010			Dustin - relatively straightforward (Fri) Paula - more changes
68	Service Handoffs - Cruise - EDL	Dustin	8/17/2010	9/1/2010	8/24/2010			

05-25 06-01 06-15 06-22 06-29 07-27 08-17 08-24

Cycle Schedule updated at weekly meetings

Strive to capture issues and concerns early so they can be addressed

Implementing the IV&V project – Communication and Training

- Communication enables domain understanding and consistency across MSL IV&V products
 - Within the IV&V team
 - We have ~monthly brown-bags where team members share expertise (e.g. 1553B, profiler, project org, etc)
 - We have weekly sub-team meetings and biweekly team meetings
 - With the NASA PM
 - Monthly “lunch” with Frank (NASA PM)
 - Frequent (daily) communication on project status and issues
 - Goal – nip concerns as soon as possible
- Training and Rotations
 - Work instructions facilitate training, but more importantly are the sessions where more experienced members work “shoulder to shoulder” with new ones
 - Participation in a subteam is constant within an analysis cycle, rotations within subteams occur
 - If activities finish early or are behind, analysts may be shifted to address a surge need (typically surge needs are 2-3 week, well defined activities)

MSL IV&V project – Interacting with the Development Project

- The IV&V project is lucky, we have had the same point of contact (POC) since the IV&V project began
- The project POC also has other roles within the MSL project
- Features of our interactions includes
 - Bi-weekly tagup – The tagups follow a set agenda and provide a forum to track artifacts, reviews and status project and IV&V activities. Any concerns are addressed with resolution plans identified
 - Bi-monthly discussions – These discussions enable a deeper technical dive into particular topics (e.g. autocoding, fault protection, issue resolution, etc). Almost always includes additional project personnel
 - IV&V attendance at technical reviews
- In the tagups and discussions, IV&V initiates the agenda and provides associated material
 - Feedback from POC is that the dialogues are extremely effective
 - In particular, kudos to IV&V on how we maintain and track action items
 - Insist that interactions have clear objectives

Example: IV&V - MSL Bi-weekly tagup

1 Agenda

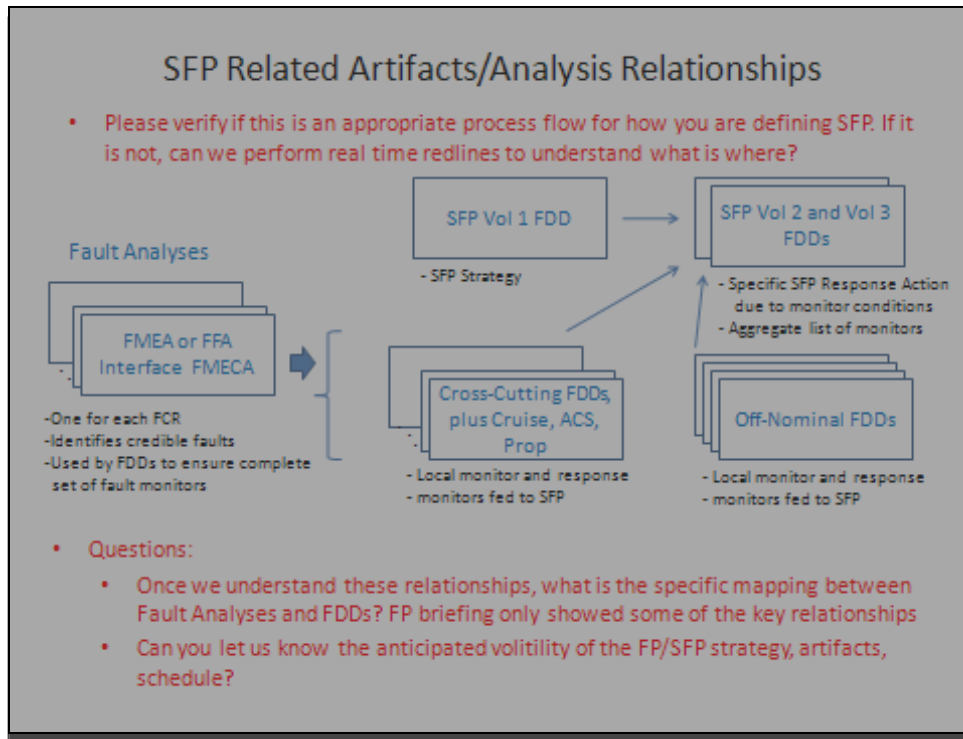
1. Agenda
2. Items of Note
3. Update on MSL Schedule/Status/Activities
4. IV&V Activities
5. Artifacts Required
6. MSL IV&V Issue Summary
7. MSL IV&V Risk Status
8. Action Item List

- Set agenda and action item list facilitates communications
- Tagup agendas are 5-9 pages in length
- We go through whole thing in 1 hour (sometimes 1.5 hours)

1	8. MSL-IV&V Action Items						
2	ID	Opened	Actionee	Status	Description	Expected Date	Comments
4	101	8/12/2010	Krasner	Open	Follow up on EDL Events and Control TIMs that are still open: 1592, 1603, 1611, 1665, 1668,, 1712		
5	102	8/12/2010	Savarino	Open	IV&V to establish position on FSW as single FCR for discussion with Sandy	9/15/2010	
6	103	8/12/2010	Krasner	Open	Sandy to establish position on FSW as single FCR for discussion with IV&V and others	9/15/2010	
7	104	8/12/2010	Savarino	Open	Establish if and if so, where is data validity during EDL checked - either in FP or interface team. The data checking would be for within appropriate bounds		
8	105	8/12/2010	Huy	Open	Provide FY 2011 IPEP		
9	106	8/12/2010	Krasner	Open	Provide artifacts for GNC algorithms. This is an apparent hole in artifacts. Paula/Shirley - enter TIMs, but don't submit until we get algorithms		9/2 - need to discuss, since we haven't received artifact, we'd like to submit TIMs, and move them TBV with anticipated artifact (follows established process and makes us not have to remember everything)
10	107	8/12/2010	Krasner	Open	Check on status of test database with Diana et al. When are there planned updates?		
11	108	8/12/2010	Krasner	Open	Provide status of Launch/Cruise/Approach test procedures and planned availability		
					Build 8 code - work with Jake and Frank to provide		

Example: IV&V-MSL bimonthly tagups

- We met with project in June 2010 to ensure our understanding of the MSL Fault Protection architecture was correct



We developed this chart as one of a 16 page presentation to guide discussions.

As a result of the meeting, IV&V was able to finalize our work instructions for this iteration of analysis.

- We also discussed verification plans, simulators, software architecture and a sensor's outstanding issues during this set of meetings.

Summary

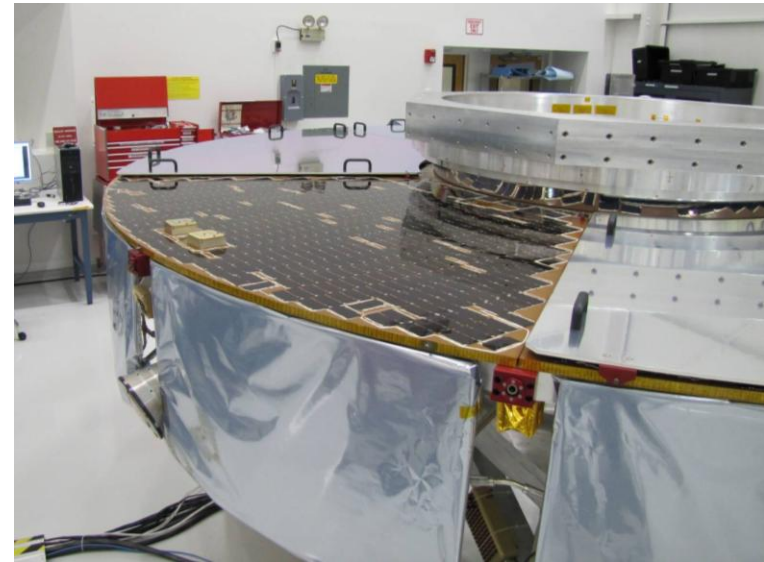
- Described techniques have helped us bridge a year of transition on the MSL project
- The techniques become successful because of the people
 - NASA project Manager
 - Project POC
 - MSL Analysts
- Additional techniques will likely be necessary to meet the challenges in the next fiscal year as the project shifts it's emphasis into test and integration

MSL Team

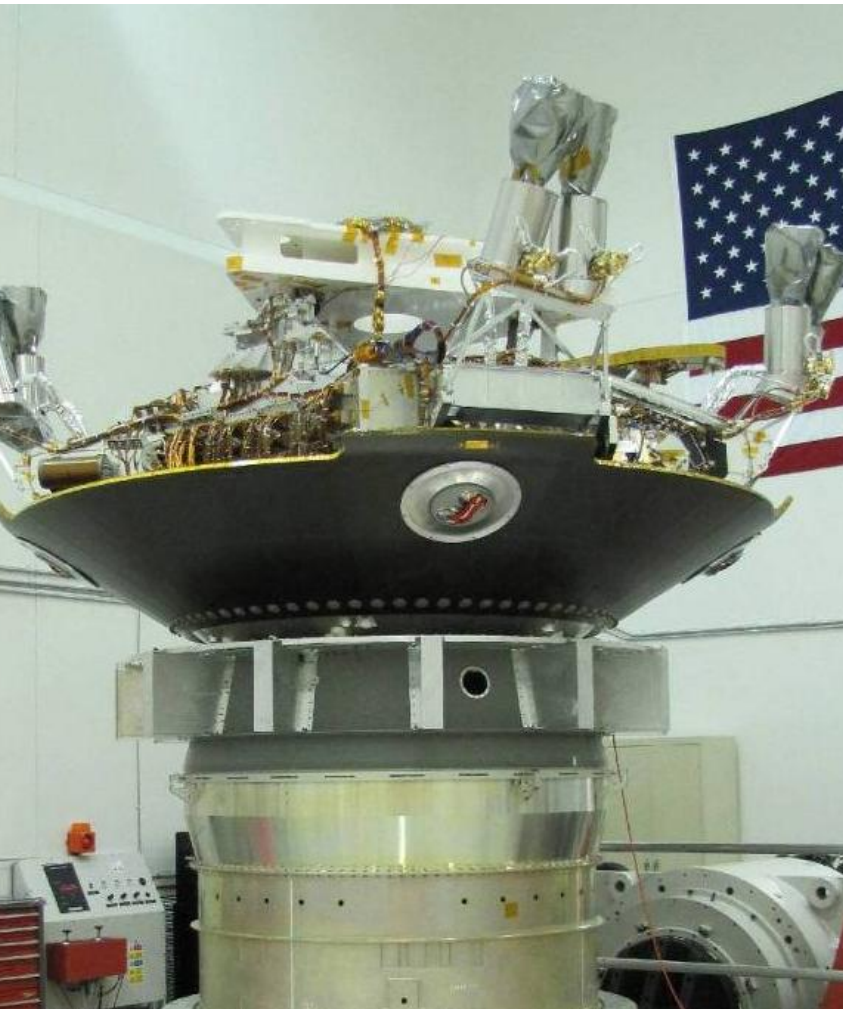
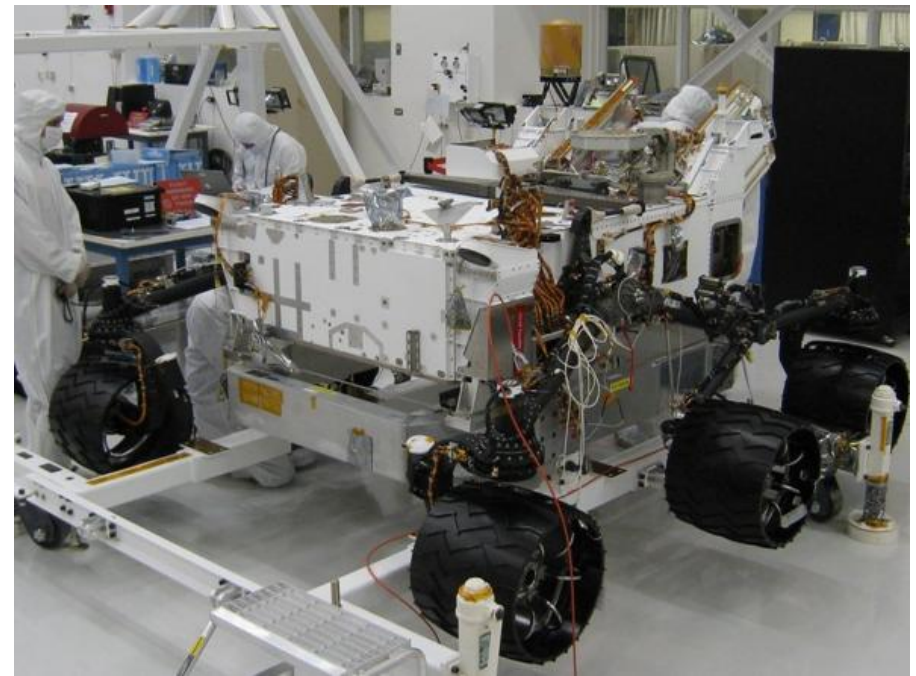
- Frank Huy (NASA PM)
- Sandy Krasner (MSL POC)
- Shirley Savarino
- Jacob Cox
- Rich Kowalski
- Pradip Matra
- Paula Baker
- Abhijit Sengupta
- Jeff Zemerick (ex)
- Randall Hintz
- Neal Saito
- Ken Ritchie
- Judy Murphy
- Dustin Whitt
- Janette Hunt
- Mike Choppa
- Jeremy Fienhold
- Marcella Williams
- Matt Cole (TQE rep)

Final Thoughts: MSL in ATLO - launch Nov 2011

Cruise Stage



Rover



Descent Stage